FINAL REPORT

HEADSET ASSEMBLIES

CONTRACT NAS 9-5155

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

By
Engineering Department
Electro-Voice, Incorporated
Buchanan, Michigan

Prepared by: Robert C. Ramsey
Robert C. Ramsey
Chief Engineer

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LIST OF ILLUSTRATIONS

1.0 INTRODUCTION

This report describes the results of work performed by the contractor in fulfilling the requirements of Contract NAS 9-5155. A complete headset assembly capable of being used inside an Apollo-type space helmet was designed and two prototype headsets were delivered to NASA on 23 March 1966.

The completed headset, as shown in Figure 1, consists of two boom mounted, dynamic, noise cancelling microphones with solid state amplifiers mounted within the boom, two dynamic earphone assemblies and mounting hardware including provisions for changing the ear-cushion clamping pressure. The system is designed for optimum operation at an ambient pressure of 5 psia. A more complete description of the headset design is included in section 2.0 of this report.

The design, testing and fabrication of the two prototype headsets was performed during the six and one-half month period starting on September 3, 1965 with the Design Coordination Meeting at NASA, Houston and ending on March 23, 1966 with the delivery of the headsets.

The important milestones in the performance of the required work are as follows:

Contract award	August 24, 1965
Design Coordination Meeting	September 3, 1965
Preliminary Design Completion	November 10, 1965
Final Design Review Meeting	December 2, 1965

Figure 1

Development Tests Completed	January 3, 1966
Delivery of Units	March 23, 1966

2.0 HEADSET DESIGN

Designing for the requirements of operation at 5 psia pressure, operation during short periods of high acoustic noise followed by relatively long periods of lower acoustic noise, minimum weight, small size and high sensitivity has resulted in a design with the following unique features:

a. A dynamic, noise cancelling microphone transducer 0.7 inches in diameter by 0.5 inches thick capable of providing a 22 db signal to noise ratio in a simulated use test, with a frequency response at 5 psia within ±3 db from 300 cps to 3000 cps.

b. An adjustable damping pressure on the earcushions for use during periods of high acoustic noise.

c. A dynamic earphone transducer 2 inches in diameter by 5/8 inches thick with a sensitivity of 111 db SPL for one milliwatt input and a frequency response within ±3 db from 300 cps to 3000 cps (both measurements at 5 psia ambient pressure).

d. A weight of 329 grams (less cable and connector).

The headset as designed consists of the following components:

a. Two microphones with self contained amplifiers.

b. Two earphone assemblies.

c. Headband and earcup support hardware.

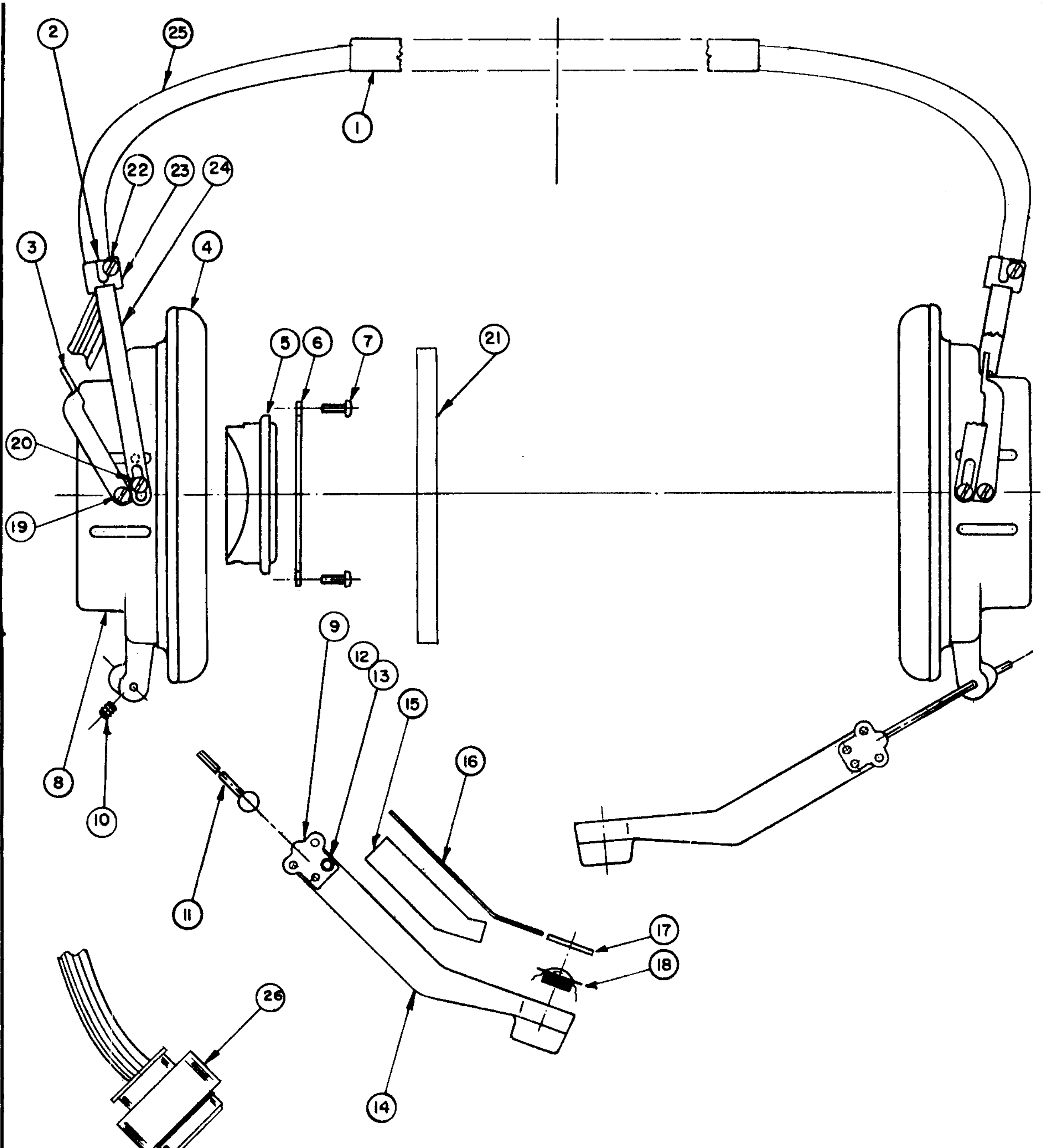
d. Connector and wiring harness.

An assembly drawing of the complete headset is shown in Figure 2.

2.1 Microphone

The microphone assembly consists of a microphone transducer, amplifier and microphone boom. When assembled, these elements

SYM	REVISIONS	DATE	APPROVAL



ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	DRG'N SIZE
26		1	CONNECTOR SHELL			
25		2	TUBING PVC SHRINK			
24		2	HINGE EARPHONE			
23		2	BEARING EARPHONE			
22			SCREW 6-32 × $\frac{1}{4}$ PAN HD.			
21		2	SCOT FOAM, 60 PPI			
20		4	SCREW 6-32 × $\frac{1}{4}$ PAN HD			
19		4	SCREW 6-32 × $\frac{5}{32}$ PAN HD			
18		2	DIAPHRAGM & VOICE COIL S/A.			
17		2	MICROPHONE COVER			
16		2	BOOM COVER			
15		2	AMPLIFIER			
14		2	BOOM			
13		4	SCREW 3-56 × $\frac{1}{2}$ SOC HEAD			
12		4	NUT 3-56 HEX NUT			
11		2	BOOM SHAFT			
10		2	SET SCREW 6-32 × $\frac{3}{16}$ SOC HD			
9		4	CLAMP SWIVEL			
8		2	EARCUP			
7		4	SCREW, 4-40 × $\frac{5}{16}$			
6		2	CLAMPING RING			
5		2	EARPHONE			
4		2	EAR CUSHION			
3		2	PRESSURE INCREASING MECHANISM			
2		1	HEAD BAND			
1		1	ISOLATION NETWORK			

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED			
FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .002	± ½°	.010 T.I.R.

· NOTES ·

UNMARKED ANGLES & INTERSECTIONS 90°. REMOVE BURRS & EXPOSED SHARP EDGES. THREADS TO BE UNIFIED SERIES CLASS 2 AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A.Q.L. —— PRINT ISSUE DATE

TITLE: N.A.S.A. HEADSET ASSEMBLY

MATERIAL —
END FINISH —
HEAT TREAT — FROM & COND —
DRAWN G.B./C.A. DATE 11-19-65
CHECKED DATE
ENGINEER DATE

Electro-Voice®
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

MODEL

CONTRACT OR CUSTOMER NO

SCALE 1:1

PART NO.

Figure 2

form an integral structure connected to the bottom of the earcup and extending forward to the side of the mouth. Adjustment of the microphone assembly is accomplished by means of a slide adjustment at the mechanical connection to the earcup and in a ball swivel at the rear of the microphone boom molding. Adjustment is sufficient to permit the microphone to be moved free of the mouth area during eating.

The electrical and acoustical design goals for the microphone that were set forth in the contract 'Statement' were achieved as evidenced by the results of the acceptance tests performed on the prototype headsets as shown in Figures 3 through 6. The electrical output at 1 KC for a SPL input of 106 db was -1 dbm, well within the limits of 0 dbm ±2 db. The frequency response curves (see Figure 5) were within the limits of ±3 db over the range of 300 cps to 3000. The noise cancellation characteristics exceeded 20 db difference between simulated voice and noise signals. An additional noise cancellation measurement in the form of close and distance frequency response curves was performed during the development tests and the result of this measurement is shown in Figure 7. The validity of noise cancellation measurements performed at ambient pressures as an indication of noise cancellation characteristics at 5 psia was also established during the development tests.

To reduce the size and weight of the microphone transducer, an Alnico IX magnet and 2V permendur steel structure are used in the magnetic assembly as shown in Figure 8.

HEADSET #1
DATA SHEET

1. Microphone Phasing:
   - A. Left microphone output **-5** db (-6 ±1 db).
   - B. Right microphone output **-6** db (-6 ±1 db).

2. Sensitivity at 1000 cps, 5 psia:
   - A. Microphone system **-1** [illegible]).
   - B. Earphones:
     - (1) Right **111 db** (110 db minimum).
     - (2) Left **111.5 db** (110 db minimum).

3. Frequency response: see attached curves.

4. Impedance at 1000 cps:
   - A. Microphone system: **570** ohms ([illegible] ohms).
   - B. Right earphone: ~~611~~ ohms ([illegible] ohms).
   - C. Left earphone: ______ ohms ([illegible] ohms).

5. Distortion:

	Microphone System		Earphones Right		Earphones Left	
cps	106 db spl	116 db spl	110 db spl	125 db spl	[illegible]	[illegible]
300	%	%	0.6 %	0.9 %	0.7 %	0.8 %
1000	.8 %	1.0 %	0.6 %	1.0 %	0.8 %	1.3 %
3000	1.0 %	2.5 %	0.7 %	0.9 %	0.7 %	1.0 %
maximum permissible	2%	5%	2%	%		5%

6. Microphone system internal noise:
   - A. Output **-54.5** dbm (-45 dbm maximum).

7. Microphone system linearity at 1000 cps:
   - A. Output for 96 db spl **-9** dbm.
   - B. Output for 106 db spl **-1** dbm.
   - C. Output for 116 db spl **+8** dbm.

8. Microphone System Clipping:

cps	spl at which clipping was observed	
300	**120.7**	(116 db minimum)
1000	**123.5**	(116 db minimum)
3000	~~**123.2**~~	(116 db minimum)

9. Microphone System current drain: **30** ma ([illegible] ma maximum)

10. Microphone system rippled output: **-54.5** dbm (-45 dbm maximum).

11. Microphone system noise cancellation:
    - A. Output for voice **11.5** dbm.
    - B. Output for noise **-11** dbm.
    - C. Difference of A and B **22.5** db (15 db minimum).

Figure 3

12. Variations of temperature and supply voltage:

Temperature	Supply Voltage	Microphone Output for 106db spl	spl at which clipping occurred (115 db minimum)
$40^{\circ}F$	24 v	+ .5 dbm	126.6 db
$40^{\circ}F$	28 v	+ .6 dbm	124.4 db
$40^{\circ}F$	32 v	+ .6 dbm	124.4 db
ambient	24 v	- 1.2 dbm	123.5 db
ambient	28 v	- 1.0 dbm	123.5 db
ambient	32 v	- 1.0 dbm	123.5 db
$90^{\circ}F$	24 v	+ .4 dbm	122 db
$90^{\circ}F$	28 v	+ .4 dbm	122 db
$90^{\circ}F$	32 v	+ .4 dbm	122 db

13. Earphone linearity:

Power Input Milliwatts	spl (db) Right	Left	
.126	95.5 db	98 db	95 db minimum
4.0	111 db	111.9 db	110 db minimum
126.4	125.5 db	128 db	125 db minimum

Figure 3

HEADSET #2

DATA SHEET

1. Microphone Phasing:
   - A. Left microphone output **-6** db (-6 ±1 db).
   - B. Right microphone output **-6** db (-6 ±1 db).

2. Sensitivity at 1000 cps, 5 psia:
   - A. Microphone system: **-1** (0 dbm ±2 db).
   - B. Earphones:
     - (1) Right **111.5 db** (110 db minimum).
     - (2) Left **111.5 db** (110 db minimum).

3. Frequency response: see attached curves.

4. Impedance at 1000 cps:
   - A. Microphone system: **570** ohms (600 ±30 ohms).
   - B. Right earphone: ~~625~~ ohms (600 ±30 ohms).
   - C. Left earphone: _____ ohms (600 ±30 ohms).

5. Distortion:

	Microphone System		Earphones Right		Earphones Left	
cps	106 db spl	116 db spl	110 db spl	125 db spl	110 db spl	125db spl
300	%	%	0.6 %	0.8 %	0.7 %	0.8 %
1000	.8 %	2.6 %	0.8 %	1.1 %	0.8 %	1.1 %
3000	1.0 %	2.0 %	0.8 %	1.0 %	0.8 %	0.9 %
maximum permissible	2%	5%	2%	5%		5%

6. Microphone system internal noise:
   - A. Output **-53** dbm (-45 dbm maximum).

7. Microphone system linearity at 1000 cps:
   - A. Output for 96 db spl **-10** dbm.
   - B. Output for 106 db spl **-1** dbm.
   - C. Output for 116 db spl **+8** dbm.

8. Microphone System Clipping:

cps	spl at which clipping was observed
300	**120.1** (116 db minimum)
1000	**123.5** (116 db minimum)
3000	**123.2** (116 db minimum)

9. Microphone System current drain: **29** ma (30 ma maximum).

10. Microphone system ripple output **-53** dbm (-45 dbm maximum).

11. Microphone system noise cancellation
   - A. Output for voice **13** dbm.
   - B. Output for noise **-10** dbm.
   - C. Difference of A and B **23** db (15 db minimum).

Figure 4

12. Variations of temperature and supply voltage:

Temperature	Supply Voltage	Microphone Output for 106db spl	spl at which clipping occurred (116 db minimum)
40°F	24 v	-1.6 dbm	122 db
40°F	28 v	~~-1.5~~ dbm	~~121.6~~ db
40°F	32 v	-1.5 dbm	121.6 db
ambient	24 v	-1.1 dbm	123.5 db
ambient	28 v	-1 dbm	123.5 db
ambient	32 v	-1 dbm	123.5 db
90°F	24 v	- .3 dbm	122 db
90°F	28 v	+ .1 dbm	121.1 db
90°F	32 v	+ .1 dbm	121.1 db

13. Earphone linearity:

Power Input Milliwatts	spl (db) Right	Left	
.126	97.5 db	96 db	95 db minimum
4.0	111.5 db	111.5 db	110 db minimum
126.4	127.5 db	126 db	125 db minimum

Figure 4

MODEL Microphone

SPECIAL NOTES

NAS 9-5155

Z ________ OHMS DATE ________

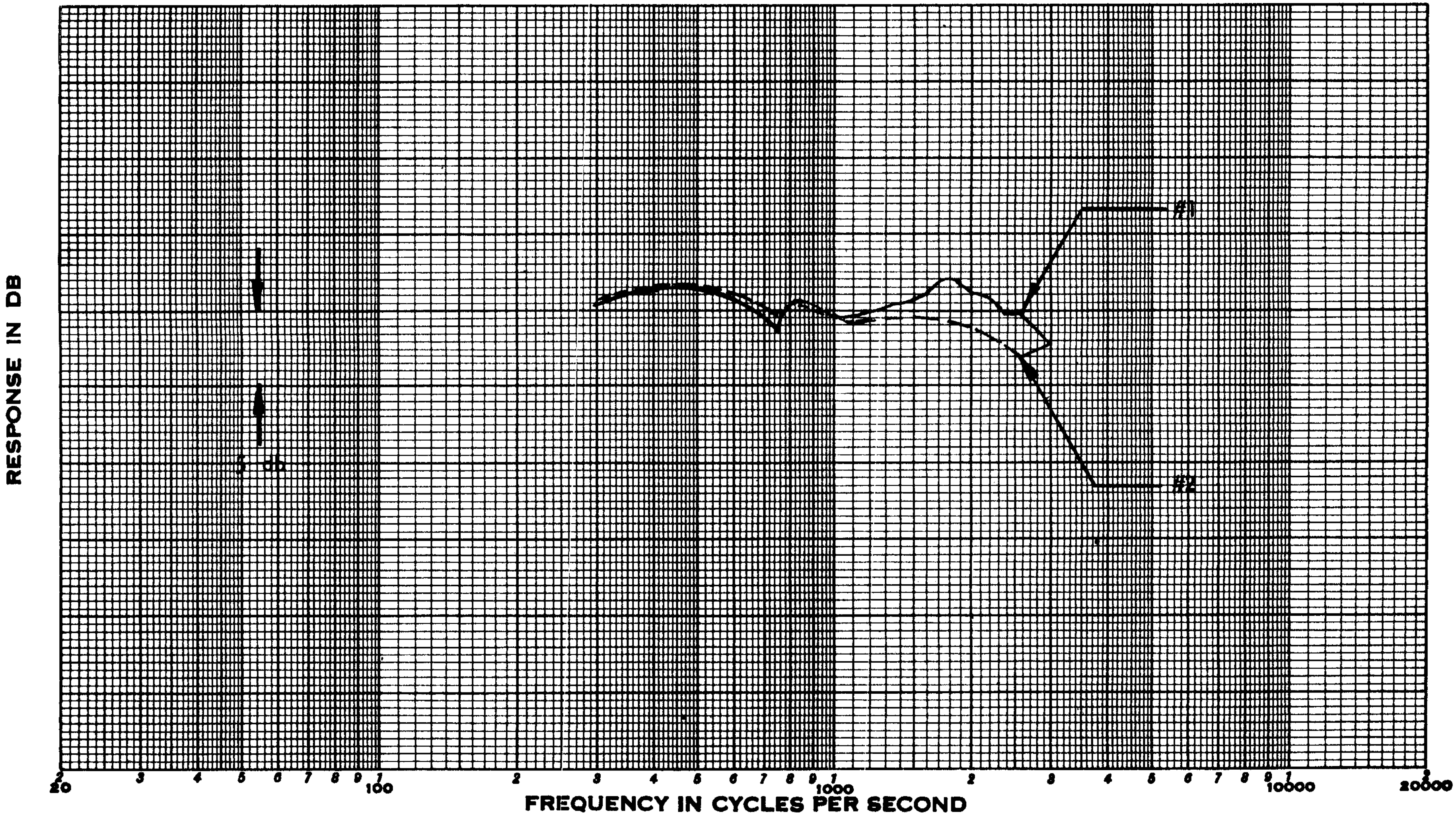
SOUND PRESSURE 106 DB re .0002 dynes/cm²

REFERENCE: 0 DB = 1 milliwatt

MICROPHONE PLACEMENT ________ inches

SENSITIVITY ________ db re 1 volt/dyne

AT 1000 CPS -1 db re 1 milliwatt/10 dynes



Electro-Voice

APPROVED ________

Figure 5

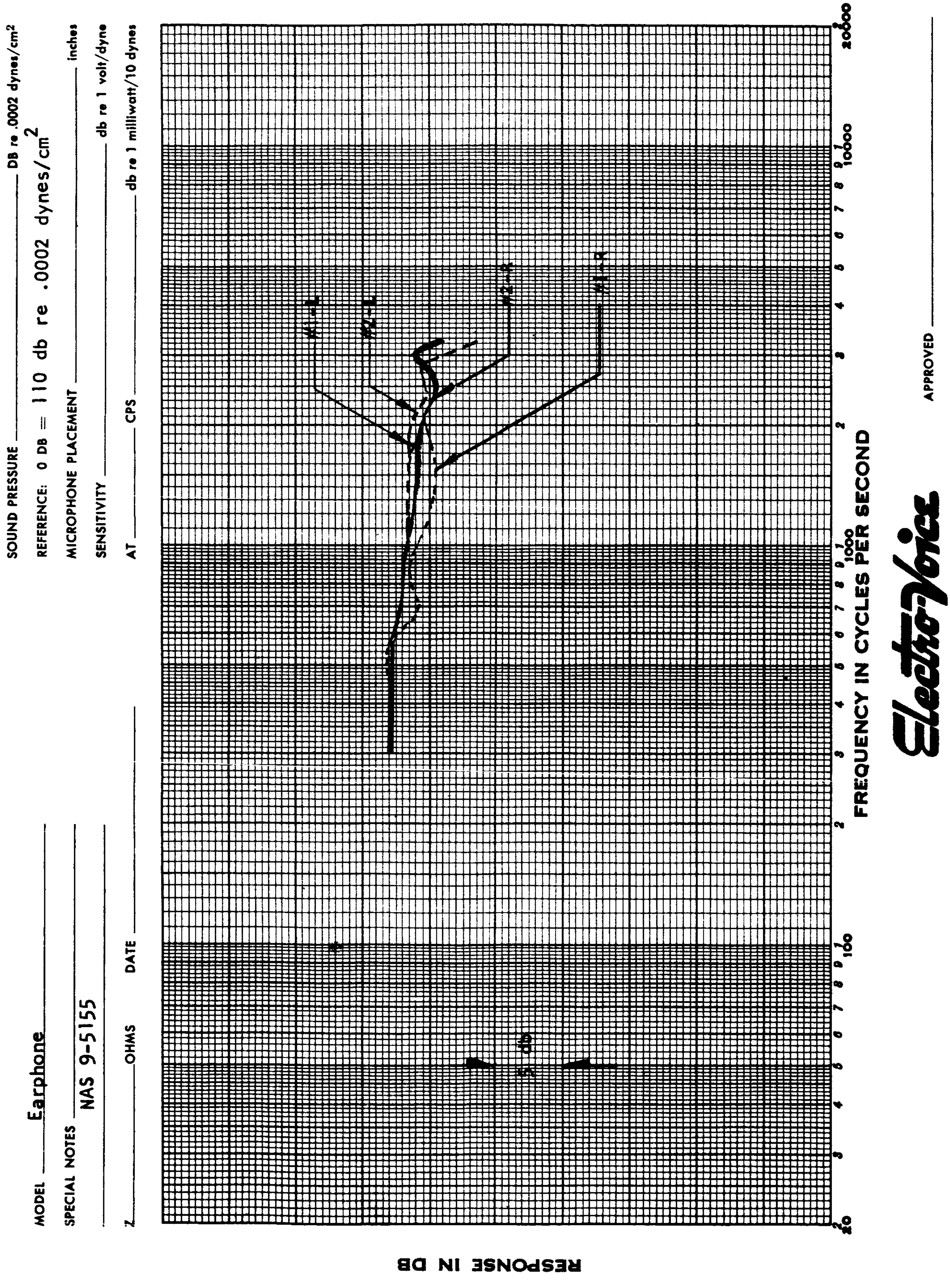
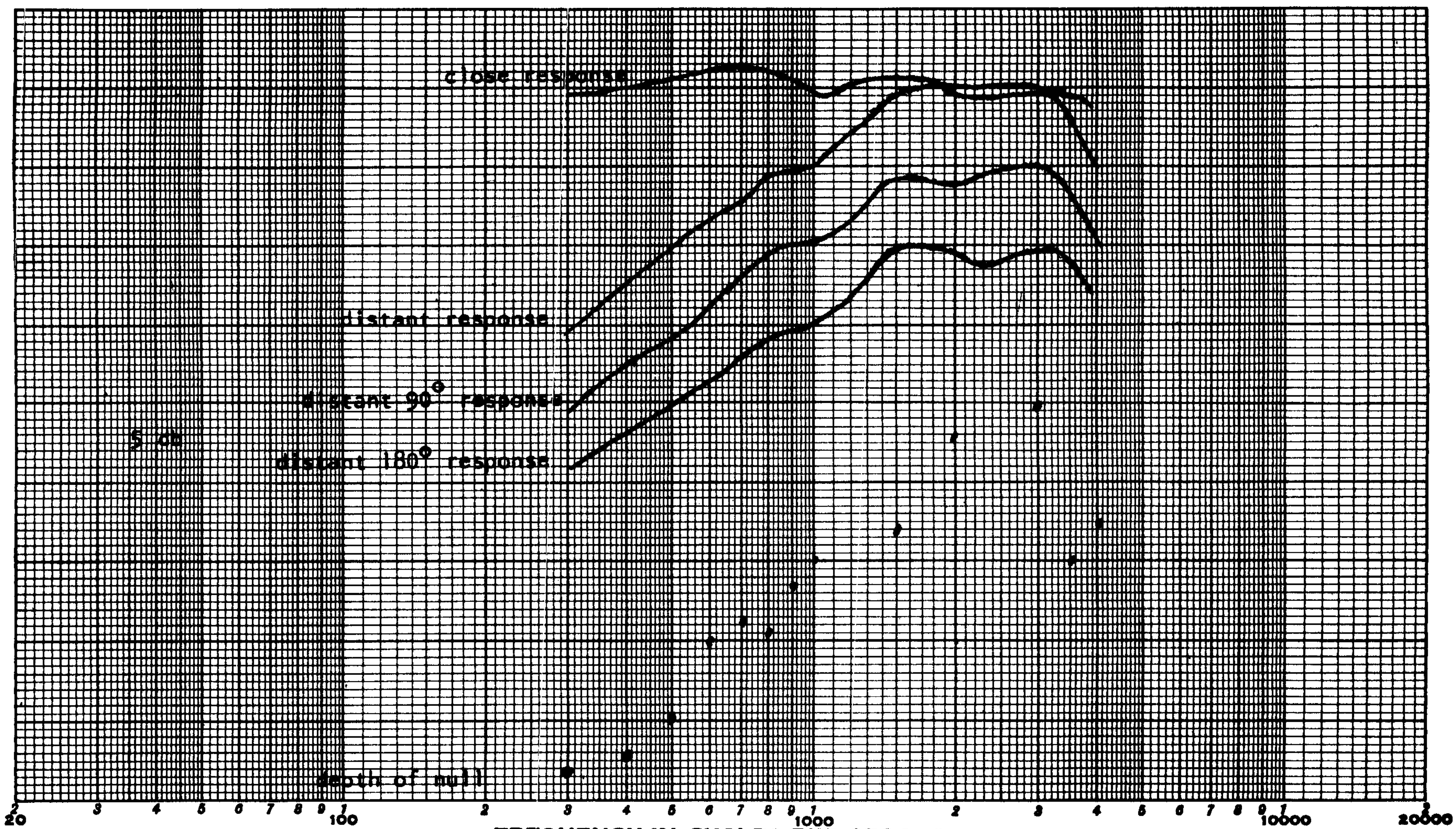

MODEL Earphone
SPECIAL NOTES NAS 9-5155
OHMS
DATE
SOUND PRESSURE DB re .0002 dynes/cm²
REFERENCE: 0 DB = 110 db re .0002 dynes/cm²
MICROPHONE PLACEMENT inches
SENSITIVITY db re 1 volt/dyne
AT CPS db re 1 milliwatt/10 dynes
RESPONSE IN DB
FREQUENCY IN CYCLES PER SECOND
20
100
1000
10000
20000
#1-L
#2-L
#2-R
#1-R
5 db
APPROVED
Electro-Voice

Figure 6

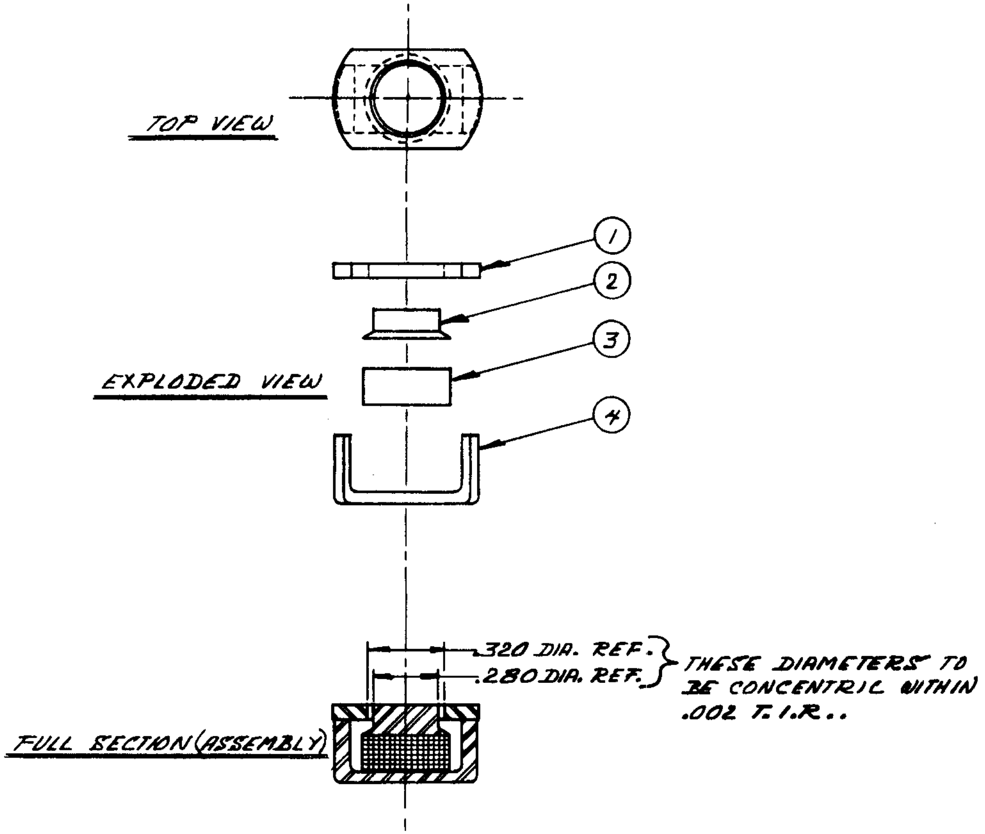
Corrected Curves
Ground Level



MICROPHONE SYSTEM

Figure 7

SYM.	REVISIONS	DATE	APPROVAL



NOTE:

1. CEMENT PARTS TOGETHER WITH RESIWELD. 1 PART OF 97012 TO 2 PARTS OF 97008 .

ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	DRG'N SIZE
4		1	YOKE			A
3		1	MAGNET			A
2		1	POLE PIECE			A
1		1	FACE PLATE			A

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES
UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .003	± ½°	.010 T.I.R.

• NOTES •

UNMARKED ANGLES & INTERSECTIONS 90°.
REMOVE BURRS & EXPOSED SHARP EDGES.
THREADS TO BE UNIFIED SERIES CLASS 2
AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A. Q. L. —— PRINT ISSUE DATE

TITLE POT STRUCTURE S/A

MATERIAL ——
END FINISH ——
HEAT TREAT —— FROM & COND. ——
DRAWN J.L.C. DATE 12-2-65
CHECKED DATE
ENGINEER DATE

Electro-Voice.
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

MODEL

CONTRACT OR CUSTOMER NO.

SCALE 2/1

PART NO.

E11-913-13

Figure 8

This assembly is insert molded as a part of the microphone boom as shown in Figure 9.

The microphone amplifiers are fabricated using welded, cordwood construction and are potted in the microphone boom. A cover is cemented over the open section of the boom to protect the cable connections and amplifier.

The amplifiers designs are shown in Figures 10 and 11. A combination regulator and capacitor multipliers is used in the power feed to permit operation over the power supply voltage variation specified (28 ±4 v. d.c.) and to reduce the affect of ripple in the supply. The amplifier is a d.c. coupled two stage amplifier utilizing d.c. bias feedback and a thermistor to provide temperature stability. The IN276 diode prevents amplifier damage due to d.c. supply voltage reversal. The amplifier is designed to operate from a 28 v. source with a 560 Ω isolation resistor.

2.2 Earphone Assemblies

The earphone assembly consists of an earphone transducer, an earcup and an earmuff (see Figure 2).

The earphone transducer is a dynamic type, constructed as an integral sub assembly to reduce acoustic and mechanical coupling to the microphone and to permit measurement of its acoustic parameters on a 6 cc coupler.

The principal problem encountered during the design of the earphone transducer was the achievement of the required sensitivity

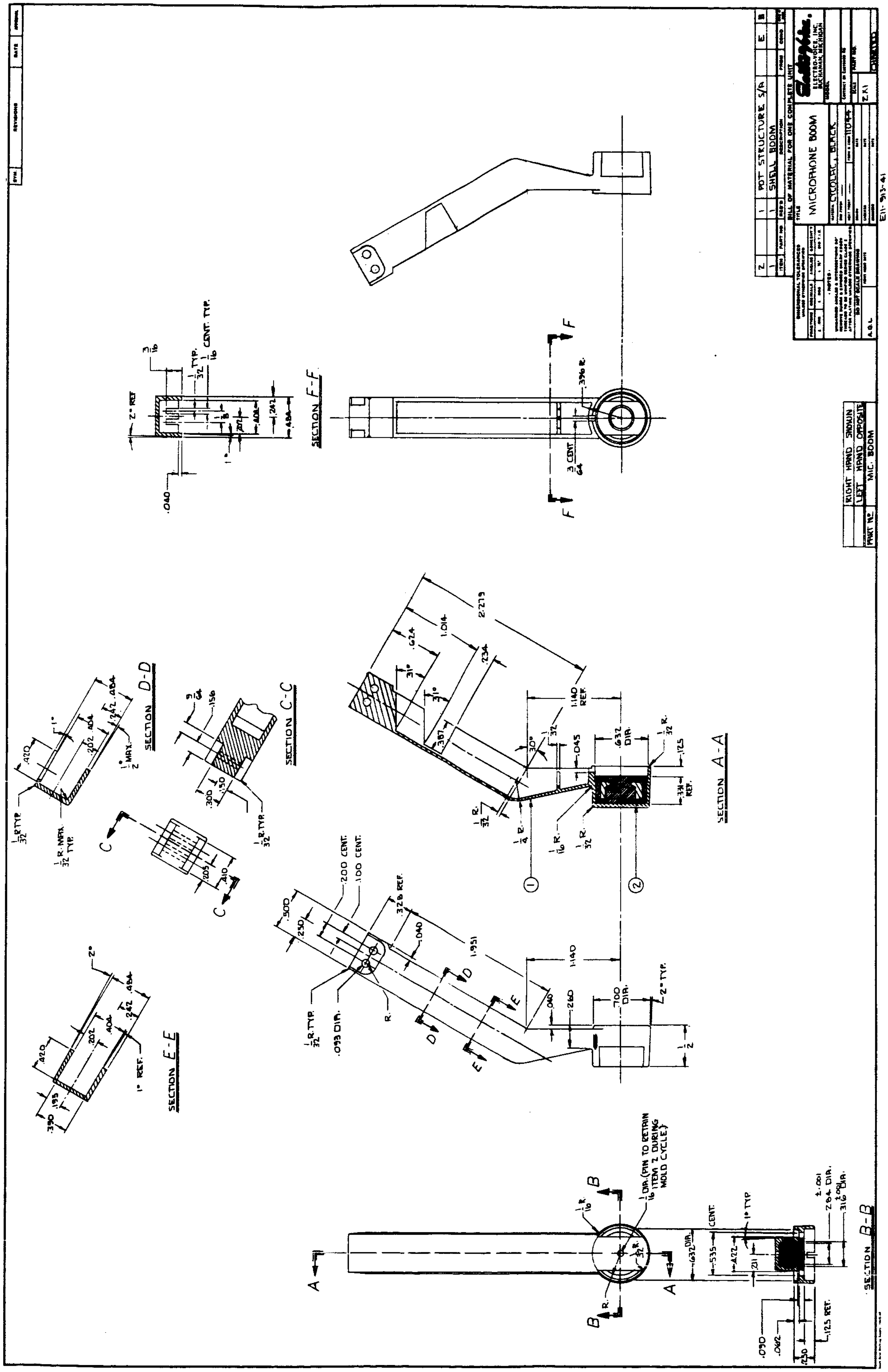
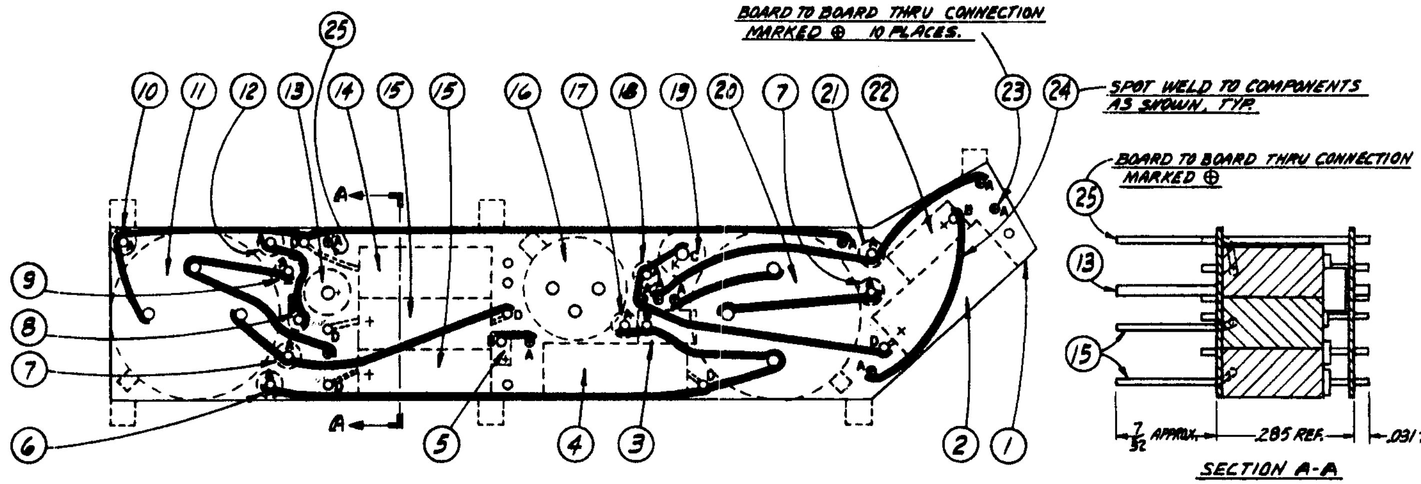
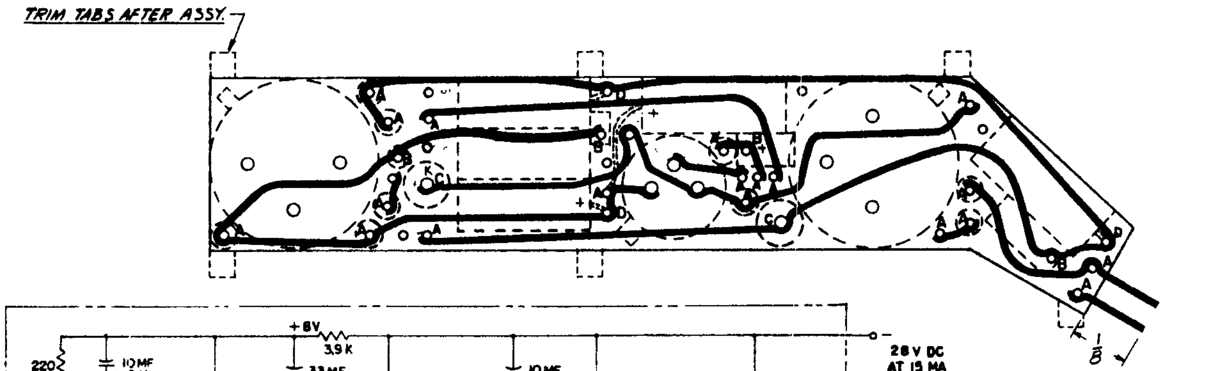
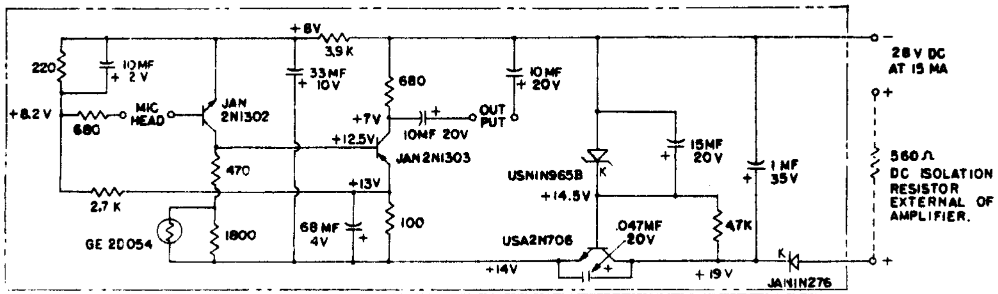

POT STRUCTURE S/A
SHELL BOOM
BILL OF MATERIAL FOR ONE COMPLETE UNIT
MICROPHONE BOOM
CYCOLAC, BLACK
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN
RIGHT HAND SHOWN
LEFT HAND OPPOSITE
MIC. BOOM
SECTION F-F
SECTION D-D
SECTION C-C
SECTION A-A
SECTION E-E
SECTION B-B

Figure 9



A -.016 DIA. TINNED COPPER WIRE.
B -.010 DIA. TINNED NICKEL WIRE.
C -.020 DIA. TINNED NICKEL WIRE.
D -.016 DIA. TINNED NICKEL WIRE.
ITEM 20 (TRANSISTOR)-.019 DIA NICKEL WIRE LEADS.
ITEMS 11 & 16 (TRANSISTORS) -.019 DIA. GOLD DEMET LEADS.





① VOLTAGES WITH RESPECT TO NEG. TERMINAL.
② RESISTORS ARE ALL 1/8 WATT, ±10% TOL.

E11-913-34

ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	ORG. N SIZE
25		1	PIN .016 DIA. TINNED COPPER WIRE 3/32 LG.			
24		AS REQD.	NICKEL RIBBON .032 x .010 THK.			
23		10	PIN, .016 DIA. TINNED COPPER WIRE, 3/32 LG.			
22		1	CAPACITOR, 1MF 35V.			
21		1	RESISTOR, 2.7 K			
20		1	TRANSISTOR, JAN 2N1302			
19		1	DIODE, ZENER, USN 1N965B			
18		1	RESISTOR, 4.7 K			
17		1	RESISTOR, 220			
16		1	TRANSISTOR, USA 2N706			
15		2	CAPACITOR, 10MF 20V.			
14		1	CAPACITOR, 68MF 4V.			
13		1	DIODE, JAN 1N276			
12		1	RESISTOR, 1800			
11		1	TRANSISTOR, JAN 2N1303			
10		1	RESISTOR, 100			
9		1	RESISTOR, 470			
8		1	THERMISTOR, GE 2D054			
7		2	RESISTOR, 680			
6		1	RESISTOR, 3.9K			
5		1	CAPACITOR, .047MF 20V.			
4		1	CAPACITOR, 33 MF 10V.			
3		1	CAPACITOR, 10MF 2V.			
2		1	CAPACITOR, 15MF 20V.			
1		1	BOARD, MTG.			

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .003	± ½°	.010 T.I.R.

· NOTES ·
UNMARKED ANGLES & INTERSECTIONS 90°. REMOVE BURRS & EXPOSED SHARP EDGES. THREADS TO BE UNIFIED SERIES CLASS 2 AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A. Q. L. — PRINT ISSUE DATE

TITLE: AMPLIFIER S/A

Electro-Voice
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

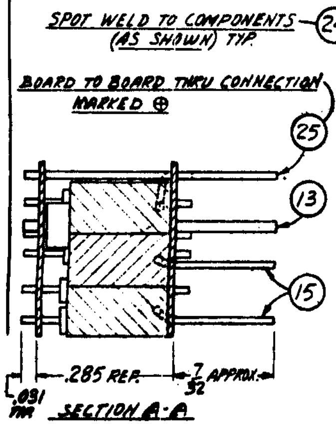
MODEL

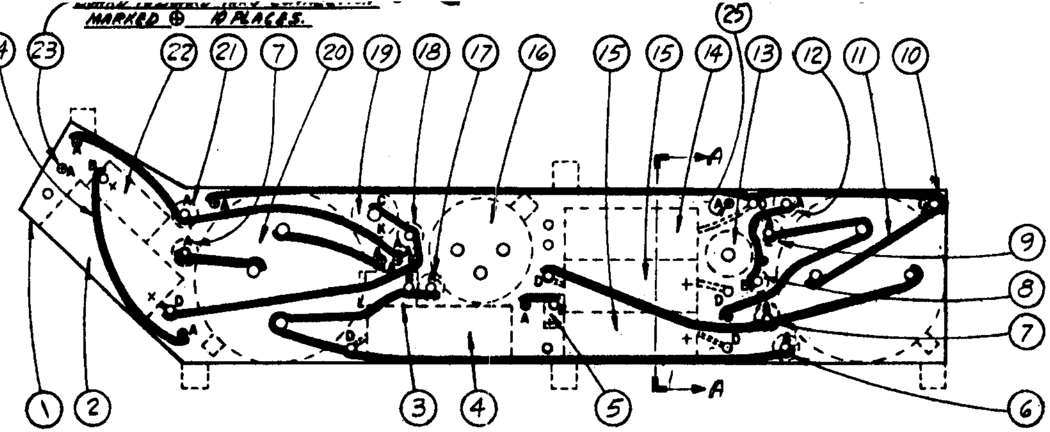
MATERIAL
END FINISH
HEAT TREAT — FROM & COND.
DRAWN C.D. — DATE 12-22-65
CHECKED — DATE
ENGINEER — DATE

CONTRACT OR CUSTOMER NO.

SCALE 5/1 — PART NO.

Figure 10





A .016 DIA. TINNED COPPER WIRE.
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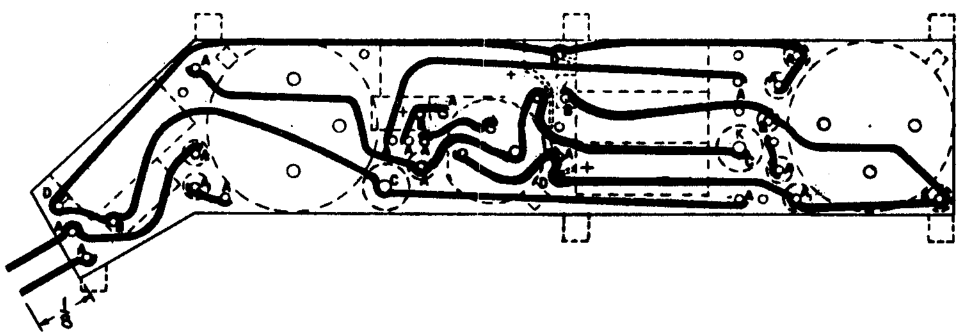
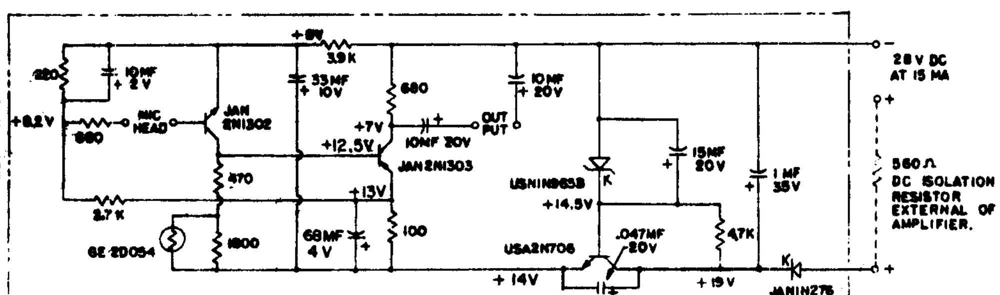
ITEMS 11 & 16 (TRANSISTORS) .019 DIA. GOLD DEMET LEADS.





① VOLTAGES WITH RESPECT TO NEG. TERMINAL.
② RESISTORS ARE ALL 1/8 WATT, ±10% TOL.

E11-913-34

ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	
25		1	PIN .016 DIA. TINNED COPPER WIRE 5/32 LG.			
24		AS REQ.	NICKEL RIBBON .032 x .010 THK.			
23		10	PIN, .016 DIA. TINNED COPPER WIRE, 5/32 LG.			
22		1	CAPACITOR, 1MF 35V.			
21		1	RESISTOR, 2.7 K			
20		1	TRANSISTOR, JAN 2N1302			
19		1	DIODE, ZENER, USN 1N965B			
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16		1	TRANSISTOR, USA 2N706			
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14		1	CAPACITOR, 68MF. 4V.			
13		1	DIODE, JAN 1N276			
12		1	RESISTOR, 1800			
11		1	TRANSISTOR, JAN 2N1303			
10		1	RESISTOR, 100			
9		1	RESISTOR, 470			
8		1	THERMISTOR, GE 2D054			
7		2	RESISTOR, 680			
6		1	RESISTOR, 3.9K			
5		1	CAPACITOR, .047MF. 20V.			
4		1	CAPACITOR, 33 MF. 10V.			
3		1	CAPACITOR, 10MF. 2V.			
2		1	CAPACITOR, 15MF. 20V.			
1		1	BOARD, MTG.			

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED			
FRACTIONS	DECIMALS	ANGLES	CONCENTY
± .010	± .005	± ½°	.010 T.I.R.

· NOTES ·
UNMARKED ANGLES & INTERSECTIONS 90°. REMOVE BURRS & EXPOSED SHARP EDGES. THREADS TO BE UNIFIED SERIES CLASS 2. AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A. Q. L. — PRINT ISSUE DATE

TITLE: AMPLIFIER S/A

MATERIAL ——
END FINISH ——
HEAT TREAT —— FROM & COND ——
DRAWN C.D. DATE 12-22-65
CHECKED DATE
ENGINEER DATE

ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN

MODEL

CONTRACT OR CUSTOMER NO

SCALE 5/1 PART NO.

-18-

Figure 11

at 5 psia (110 db SPL at 1 KC for 1 millivolt input) without exceeding the weight goal of 49 grams. These objectives were successfully achieved as evidenced by the measurements performed on the prototype headsets (see Figures 3 and 4). The weight of each prototype earphone transducer was 43 grams.

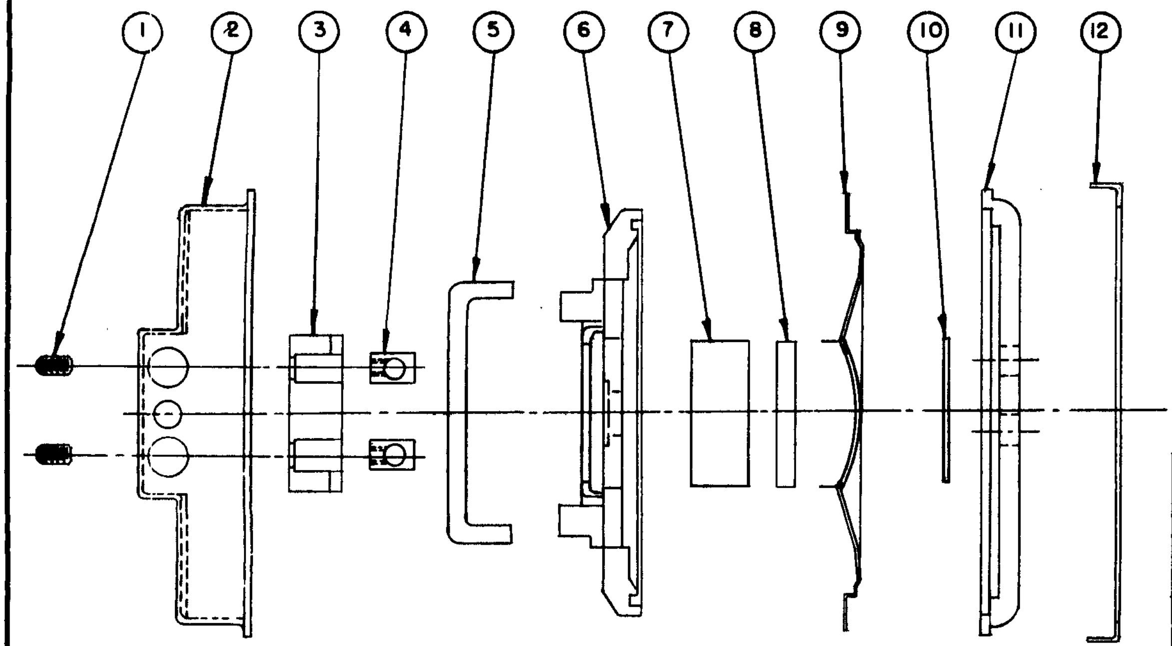
To obtain maximum sensitivity a magnetic structure using an Alnico IX magnet and 2V permendur steel has been utilized. The assembly of these parts is shown in Figure 12. The weight of the assembly was kept to a minimum through the use of an ABS plastic cover and an aluminum rear case.

The frequency response curves of the prototype earphone transducers (measured at 5 psia) are shown in Figure 6. The results of the remaining acceptance tests on the earphone transducer are shown in Figures 3 and 4.

The transducer impedance was achieved without the use of transformers through the utilization of fine wire (#49) copper voice coils. The compatibility of this small diameter wire with the requirement of the 'Statement of Work' for a power handling capability of 50 mw was successfully demonstrated during the development tests.

The basic function of the earcup and earcushion is to provide an area surrounding the ear in which external noise is attenuated. Measurement of the earcup attenuation by objective methods was performed during the development tests and results of this test, which conform to the requirements in the 'Statement of Work' are shown in Figure 13.

SYM.	REVISIONS	DATE	APPROVAL



ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	DRG'N SIZE
12		1	CLAMP EARPHONE			A
11		1	COVER FRONT EARPHONE			B
10		1	GRILLE SCREEN			A
9		1	DIAPHRAGM VOICE COIL S/A			B
8		1	POLE PIECE			A
7		1	MAGNET			A
6		1	FRONT PLATE S/A			B
5		1	YOKE EARPHONE			A
4		2	INSERT (TERMINAL BLOCK)			A
3		1	BLOCK			A
2		1	CASE EARPHONE			B
1		2	SET SCREW 2-56 × 1/16 SLOTTED HDLESS			

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES
UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .003	± ½°	.010 T.I.R.

· NOTES ·

UNMARKED ANGLES & INTERSECTIONS 90°.
REMOVE BURRS & EXPOSED SHARP EDGES.
THREADS TO BE UNIFIED SERIES CLASS 2
AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A.Q.L.

PRINT ISSUE DATE

TITLE

EARPHONE S/A

MATERIAL

END FINISH

HEAT TREAT

FROM & COND

DRAWN B PLOMB DATE 4-28-66

CHECKED DATE

ENGINEER DATE

Electro-Voice.
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

MODEL

CONTRACT OR CUSTOMER NO.

SCALE
NONE

PART NO.

Figure 12

EARCUP ATTENUATION

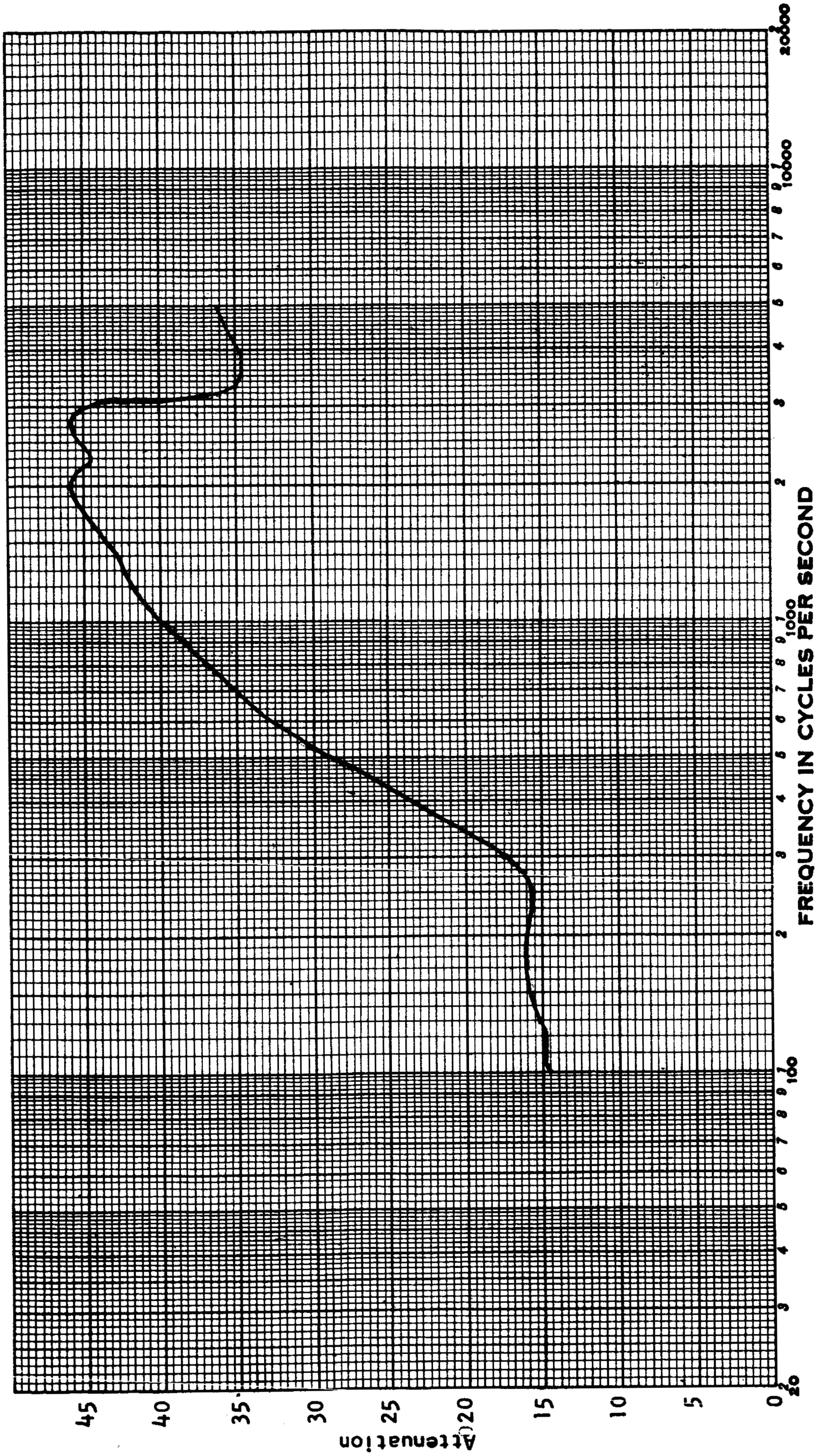


Figure 13

The earcups were fabricated from ABS plastic and contain metal inserts for fastening purposes. The earphone transducer is secured to the earcup by means of a metal plate as shown in Figure 2. The earcushion is a plastic foam cushion heat sealed inside a vinyl cover. The cushion is stretched over a backing plate that is shaped to conform to normal head dimensions.

2.3 Headband and Earcup Support Hardware

The headset is supported on the head by the headband which also provides the clamping force which seals the earcushions against the head. The headband consists of two 0.113 diameter steel wires joined at each end by nylon blocks which are attached by a sliding fit to aluminum yokes. The yoke is attached to the earcup by a swivel which permits an increase in clamping by means of a U shaped bar which is rotated from the top of the earcup to the bottom of the earcup. This feature allows the user to increase the clamping pressure on the earcushions and thereby increase noise attenuation during periods of high noise environment. The headband also supports the electrical terminal box at its center. The exposed portions of the headband are covered with PVC shrink tubing.

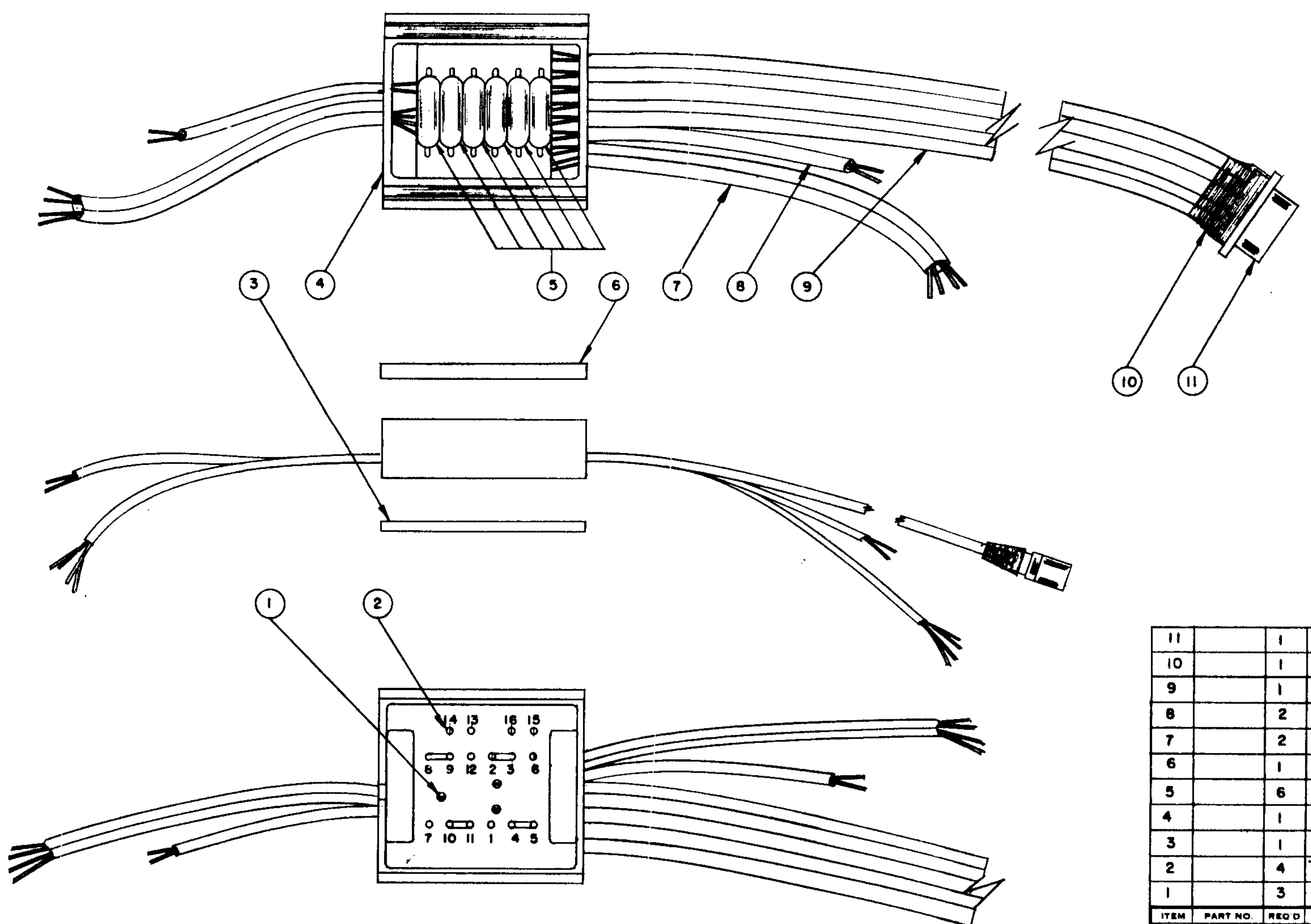
2.4 Connector and Wiring Harness

The headset is designed to connect to the Apollo communications system by means of a MD1-21SL1 Cannon insert mounted in an 832-1 Air Lock housing. The connector is wired to a five, shielded pair cable. Each pair is insulated from all other pairs in a woven, flat construction. This cable attaches to the headset at a terminal block mounted on the headband at the top of the headset. The terminal block contains terminations for the five pair cable, the isolation networks, and terminations for the cables connecting the microphones and earphones. The wiring harness and termination block are shown in the drawing on page 24 (Figure 14).

The two pair cable connecting the microphone to the terminal block is threaded through the earcup to avoid mechanical interference with the pressure adjusting mechanism.

The wiring of the headset, including pin connections to the Cannon insert, is shown in Figure 15.

SYM	REVISIONS	DATE	APPROVAL



ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	DRG'N SIZE
11		1	INSERT MDI 21 SLI			
10		1	TUBING PVC SHRINK			
9		1	NYLON BRAIDED PVC INSULATION 30" LONG			
8		2	NYLON BRAIDED PVC INSULATION 11" LONG			
7		2	NYLON BRAIDED PVC INSULATION 17" LONG			
6		1	COVER BOTTOM (NETWORK)			
5		6	RESISTOR 600 OHMS 1½ WATTS WIRE WOUND 1%			
4		1	CASE (NETWORK)			
3		1	COVER TOP (NETWORK)			
2		4	TERMINAL PIN (NETWORK)			
1		3	POST STAY CORD			

BILL OF MATERIAL FOR ONE COMPLETE UNIT

DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .003	± ½°	.010 T.I.R.

· NOTES ·

UNMARKED ANGLES & INTERSECTIONS 90°. REMOVE BURRS & EXPOSED SHARP EDGES. THREADS TO BE UNIFIED SERIES CLASS 2 AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A. Q. L. — PRINT ISSUE DATE

TITLE: CABLE HARNESS S/A

Electro-Voice. ELECTRO-VOICE, INC. BUCHANAN, MICHIGAN

MODEL

MATERIAL

END FINISH

HEAT TREAT — FROM & COND

CONTRACT OR CUSTOMER NO

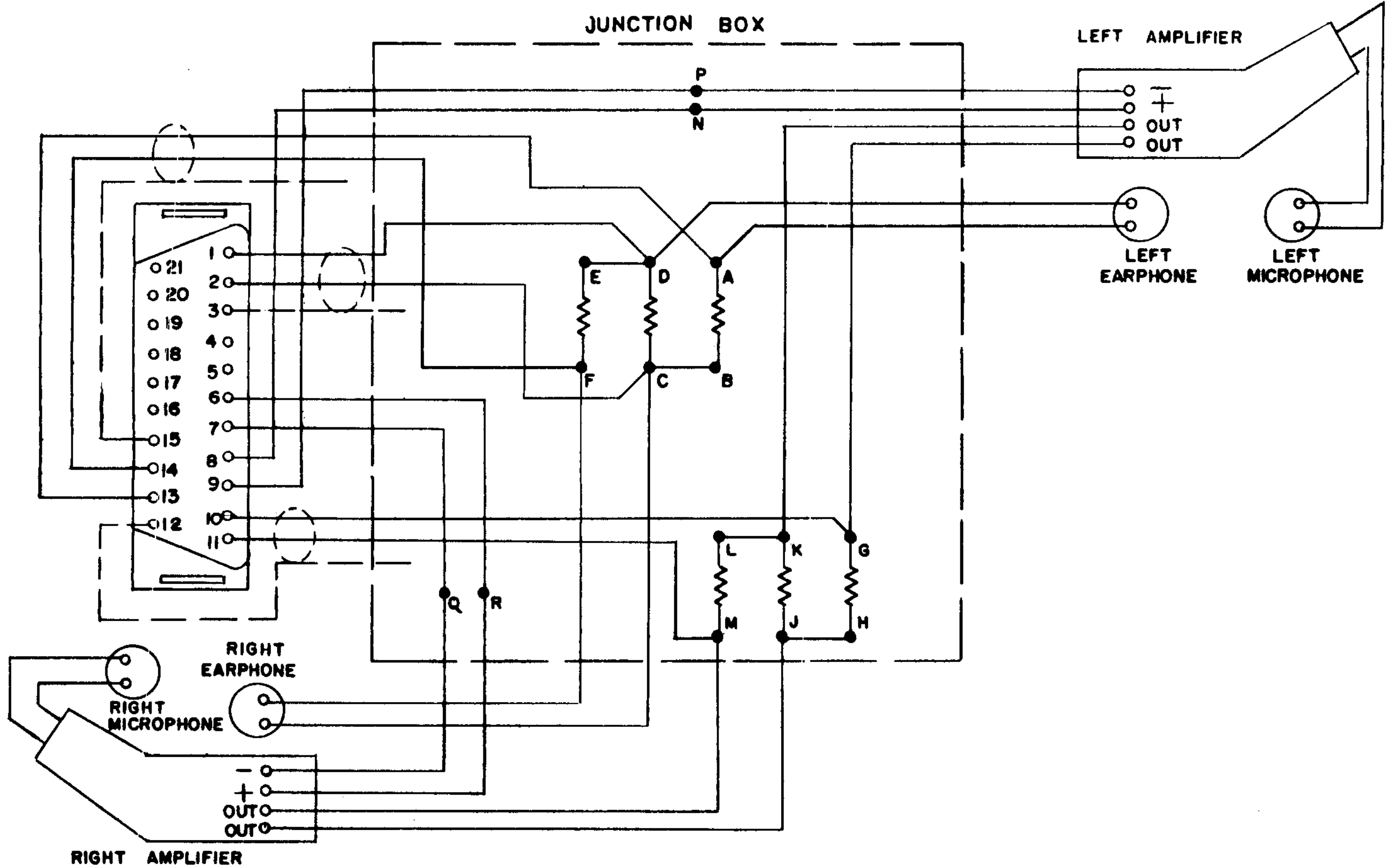
DRAWN B PLOMB — DATE 4-28-66

CHECKED — DATE

ENGINEER — DATE

SCALE 2:1 — PART NO.

Figure 14



1 & 2	AUDIO WARNING
3	SHIELD AUDIO WARNING
6 & 7	RIGHT MICROPHONE POWER 6 + 7 −
8 & 9	LEFT MICROPHONO POWER 8 + 9 −
10 & 11	MICROPHONE SIGNAL OUTPUT
12	SHIELD MICROPHONE SIGNAL
13 & 14	EARPHONE SIGNAL INPUT
15	SHIELD EARPHONE SIGNAL

SYM.	REVISIONS	DATE	APPROVAL

ITEM	PART NO.	REQ'D	DESCRIPTION	FROM	COND.	DRG'N SIZE
			BILL OF MATERIAL FOR ONE COMPLETE UNIT			

DIMENSIONAL TOLERANCES
UNLESS OTHERWISE SPECIFIED

FRACTIONS	DECIMALS	ANGLES	CONCENT'Y
± .010	± .003	± ½°	.010 T.I.R.

• NOTES •
UNMARKED ANGLES & INTERSECTIONS 90°.
REMOVE BURRS & EXPOSED SHARP EDGES.
THREADS TO BE UNIFIED SERIES CLASS 2
AFTER PLATING UNLESS OTHERWISE SPECIFIED.

DO NOT SCALE DRAWING

A. Q. L.　PRINT ISSUE DATE

TITLE
CABLE HARNESS SCHEMATIC

MATERIAL
END FINISH
HEAT TREAT　FROM & COND
DRAWN B PLOMB　DATE 4-28-66
CHECKED　DATE
ENGINEER　DATE

Electro-Voice.
ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN

MODEL
CONTRACT OR CUSTOMER NO.
SCALE NONE
PART NO.

Figure 15

3.0 CONCLUSIONS AND RECOMMENDATIONS

The headset design as represented by the two prototype units delivered to NASA meet the electrical and acoustic design goals as stated in the contract 'Statement of Work' (par 4.7.1) and the contractor's technical proposal. The weight of the completed headset is 329 grams (less cable and connector) well under the original estimate of 338 grams.

Some specific recommendations concerning the headset design are as follows:

a. The microphone amplifier has been designed to operate from a 28 ±4 volts d.c. supply with a 560 ohm isolation resistor. Specifying the supply in this manner, rather than as specified in paragraph 4.7.1.1.10 of the 'Statement', permits the utilization of the isolation resistor as a part of the microphone amplifier power supply filter, since transients peaks and ripple voltages are now considered as appearing in the 28 volt supply.

b. The noise attenuation measurement shown in Figure 13 should be considered as being optimum since leakage around the earcushion during actual use will reduce the earcup attenuation, especially at low frequencies.

c. The utilization of magnets with very high energy products (B x H) results in the generation of magnetic leakage fields in the area immediately surrounding the earphone and microphone transducers. Though no requirements are stated for the magnitude of these leakage fields, their existance, we feel, should be noted.

d. No provision for support of the headset during periods of high acceleration has been provided in the headset design. Some provision for this support should be provided, preferably in the helmet design.